In the marsupial order, the present large extinct Carnivore, for which the author proposes the name of '*Thylacoleo* carnifex*,' is most nearly allied to the *Dasyurus* (*Sarcophilus*) *ursinus*; but is very different in its dentition from that and all existing Carnivora.

The fossils described were discovered by William Adeney, Esq., in a calcareous conglomerate stratum in a bank of a lake situated 80 miles south-west of Melbourne, Australia.

IV. "On the Nature of the Action of Fired Gunpowder." By Lynall Thomas, Esq. Communicated by Dr. Gray. Received November 17, 1858.

(Abstract.)

Since the year 1797, when Count Rumford made his experiments for ascertaining the initial force of fired gunpowder, an account of which appears in the Philosophical Transactions of that year, very little light has been thrown on the subject. Count Rumford's experiments, valuable in many respects, afforded indeed nothing conclusive respecting it.

The object of the present paper is to show the unsatisfactory nature of the present theory of the action of gunpowder, and to point out some of the principal errors upon which this theory is based. For this purpose, the results of various experiments made by the author, and which were repeated in the presence of a Select Committee at Woolwich, are described and explained.

These experiments are held by the author not only to afford complete evidence of the unsoundness of the present theory, but as sufficiently conclusive to serve as a basis for the formation of a new set of formulæ, both correct and simple, in place of those at present in use.

The initial action of the fired charge of powder upon the shot,—the first movement of the shot itself in the gun,—and the force exerted upon the gun by different charges of powder,—and, therefore, the actual strength of metal required for the gun,—are circumstances, which, as the author believes, have not only been misunderstood, but for which laws have been assigned directly opposed to the truth.

* From θύλακος, *a pouch*; λέων, *a lion*.

As an instance of this, the hitherto received theory supposes that when a shot is fired from a gun, it acquires its velocity gradually, from the pressure of the elastic fluid generated by the fired powder acting upon it through a certain space. It is also supposed that the initial pressure of this elastic fluid is the *same* in all cases (the quantities of powder being proportional), whether the gun from which the shot is fired be large or small; so that the larger the calibre of the gun, the slower the first movement of the shot is supposed to be. The result of the following experiment is given to prove that the first of these propositions is incorrect. The author placed a cast-iron shot 3 inches in diameter and 3 lbs. 14 ozs. in weight upon a chamber half an inch in diameter and half an inch deep. This chamber was formed in a block of gun-metal, and contained, when filled, one dram of powder. Upon lighting the powder, the ball was driven to a height of 5 feet 6 inches; when the ball was placed at $\frac{1}{8}$ of an inch over the chamber, the charge failed to move it.

From this it is inferred that the first force of the powder is an *impulsive* force, that is to say, it imparts to the shot at once a finite velocity. In order to place the matter beyond a doubt, and to ascertain the relative force of different quantities of powder, the author caused a chamber to be made similar in form to, but of twice the linear dimensions of, the former; he then placed a cast-iron ball of 6 inches in diameter upon the orifice of this chamber, which was filled with powder; upon firing the latter, the ball was driven up to a height of 11 feet, that is to say, to double the height of the smaller; the state of the metal in which the chamber was formed also showed the increase in the initial force of the powder: this is considered to be sufficient proof that the last two of the above-mentioned propositions are as incorrect as the first.

Assuming the initial force of the powder to be of an impulsive nature, it is not difficult to understand the increase of force shown in the last-named experiment, inasmuch as a certain time being required for the complete conversion of the powder into an elastic fluid, a quantity contained in a chamber of a similar form, but of greater linear dimensions than another, must ignite in a less comparative time, the linear dimensions increasing in the ratio of the first power, and the quantity of powder increasing in the ratio of the third power, so that the flame will traverse a larger quantity in comparative less time.

Thus it appears that the powder which inflames more rapidly has a much greater initial force, being more *concentrated* in its action; a quick burning powder therefore is better for ordnance of small length, such as mortars and iron howitzers. The different results produced by powder of different quality have, according to the author, been entirely overlooked in the hitherto received theory. This theory, which considers the *secondary* force, namely, the elasticity of the fluid only, and takes no account whatever of the enormous impulsive, or initial force, produced by the sudden conversion of the powder into an elastic fluid, is that which regulates the system upon which ordnance are at present constructed; hence the reason why large guns are so liable to burst, so much so, that it has been said that no gun larger than a 32-pounder is safe to fire. From the variety of experiments made by the author, he arrives at the conclusion, that when powder is of the same quality, and confined in chambers of similar form, but of different sizes, the initial force varies, within certain limits, in the ratio of $\frac{w^{\frac{4}{3}}}{w'}$, where w is the weight of the powder and w' of the ball.

Thus were this new theory recognized, the question of the increase of strength with increased thickness of metal, would wear an entirely new aspect. So far from the metal in large guns diminishing in strength in the proportion assumed, it will be a matter for inquiry how it resists the great strain to which it is subjected, rather than why it yields; for we find from the experiments described above, that a 68-pounder gun, which has a calibre of twice the diameter of a 9-pounder gun, must, when fired with the same proportionate charge of powder as the latter, continually be subject to as great a strain as the latter would suffer if always fired with the proof charge, which is three times the quantity of the ordinary service charge.

The Society adjourned to January 6, 1859.